LISTING OF CLAIMS

1. (Original) A method for detecting a target fluid in a fluid sample comprising a first fluid and the target fluid using photoacoustic spectroscopy (PAS), the method comprising:

a) providing a light source configured to introduce an optical signal having at least one wavelength into the fluid sample;

b) modulating the optical signal at a desired modulation frequency such that the optical signal generates an acoustic signal in the fluid sample;

c) measuring the acoustic signal with an acoustic transducer; and

d) using the phase of the acoustic signal to detect the presence of the target fluid.

2. (Original) The method of claim 1 wherein the desired modulation frequency in step b) is greater than the relaxation rate of at least one of the first and target fluids.

3. (Original) The method of claim 1 wherein step c) includes performing a rotation transformation using a phase rotation angle so as to determine signal contributions from the target fluid.

4. (Original) The method according to claim 3, further including selecting an optimum phase rotation angle.

5. (Original) The method of claim 1 wherein step c) includes rotating the phase of the acoustic signal so as to suppress signal contributions of the first fluid.

6. (Original) The method of claim 5 wherein the received acoustic signal is rotated by an amount equal to the sum of the instrument phase lag and the phase lag of the first fluid.

7. (Original) The method according to claim 1 wherein step c) is carried out using an adjustable reference frame.

8. (Original) The method according to claim 6 wherein step c) includes pre-setting the adjustable reference frame to a predetermined value.

9. (Original) The method according to claim 1 wherein step c) is carried out using an in-phase receiver and a quadrature-phase receiver that are each phase-locked to the modulation of the optical signal.

10. (Original) The method according to claim 1 wherein step c) is carried out using a single receiver having an adjustable phase.

11. (Original) The method according to claim 1 wherein the optical signal in step (a) comprises light having a wavelength selected such that the target fluid resonates at that wavelength.

12. (Original) The method according to claim 1 wherein the modulation frequency is greater than 30 kHz.

13. (Original) The method according to claim 1, further including the step of optimizing the difference in phase lag between the first and target fluids by optimizing the modulation frequency.

14. (Original) An apparatus for detecting a target fluid in a fluid stream containing a first fluid and the target fluid using photoacoustic spectroscopy (PAS), the method comprising:

a light source configured to introduce an optical signal having a wavelength into the fluid stream, said optical signal being modulated at a modulation frequency having a desired modulation frequency such that the optical signal generates an acoustic signal in the fluid stream, said acoustic signal having a phase shift;

a acoustic detector for detecting said acoustic signal in at least two phases so as to obtain two output signals; and

a microprocessor for using the phase shift of said acoustic signal to convert said two output signals into information indicative of the presence of the target fluid.

15. (Original) The method of claim 14 wherein said desired modulation frequency is greater than the relaxation rate of at least one of the first and target fluids.

16. (Original) The method of claim 14 wherein said microprocessor performs a rotation transformation using a phase rotation angle so as to determine signal contributions from the target fluid.

17. (Original) The method according to claim 16 wherein said microprocessor performs a rotation transformation using an optimized phase rotation angle.

18. (Original) The method according to claim 14 wherein said acoustic detector includes an adjustable reference frame.

19. (Original) The method according to claim 14 wherein the wavelength of the optical signal is selected such that the target fluid resonates at that wavelength.

20. (Original) The method according to claim 14 wherein the modulation frequency is greater than the inverse of the relaxation time of at least one of the first and target fluids.

21. (Original) The apparatus according to claim 14 wherein said modulation frequency is greater than 30 kHz.